PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-294194

(43)Date of publication of application : 26.10.1999

(51)Int.Cl. F02D 9/02
F02D 11/10
F02D 41/20
F02D 41/22
H02P 8/38

(21)Application number : 10-106650

(22)Date of filing : 16.04.1998

(71)Applicant : TOYOTA MOTOR CORP

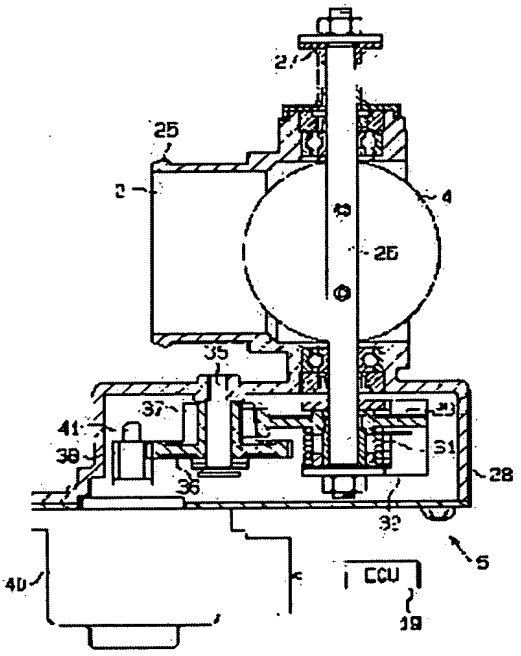
(72)Inventor : ITO YOSHIYASU

(54) CONTROL METHOD AND DEVICE FOR STEP MOTOR TYPE VALVE DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To suitable restrain the occurrence of stepping-out the like due to the reduction in the driving voltage of a step motor in controlling the step motor type valve device.

SOLUTION: An intake throttle valve 4 arranged inside an intake passage 2 is driven by a step number control making a reference of a prescribed step position of a step motor 40. When the voltage of a battery to be supplied to the step motor 40 decreases below a prescribed voltage, an electric control device 19 set the target opening value of the intake throttle valve 4 to a value, for instance, corresponding to the full-open position of the same intake throttle valve 4.



LEGAL STATUS

[Date of request for examination] 17.02.1999

[Date of sending the examiner's decision of rejection] 02.11.1999

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	11-19428
[Date of requesting appeal against examiner's decision of rejection]	02.12.1999
[Date of extinction of right]	

Japanese Publication number : 11-294194 A

CLAIMS

[Claim(s)]

[Claim 1] The control approach of the step motor type valve gear characterized by making opening desired value of said valve into a fixed value when it is the control approach of a step motor type valve gear of making a valve opening and closing said valve based on the number-of-steps control on the basis of the predetermined step location of the step motor by which drive connection was carried out, the driver voltage of said step motor is supervised and this driver voltage becomes below a predetermined electrical potential difference.

[Claim 2] For the opening desired value of this inhalation-of-air throttle valve which is an inhalation-of-air throttle valve prepared in a Diesel engine's inhalation-of-air path, and is made into a fixed value based on the driver voltage of said step motor becoming below a predetermined electrical potential difference, said valve is the control approach of the step motor type valve gear according to claim 1 which is an evacuation location equivalent value according to an engine condition.

[Claim 3] The control approach of the step motor type valve gear according to claim 2 which makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the open position of this inhalation-of-air throttle valve, or its near.

[Claim 4] The control approach of the step motor type valve gear according to claim 2 or 3 which makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the closed position of this inhalation-of-air throttle valve, or its near when abnormalities in a system or ignition switch of the engine concerned is OFF.

[Claim 5] It is what carries out check processing of the relation between the predetermined step location of said step motor, and the opening of said class throttle valve in the open position of this inhalation-of-air throttle valve on the occasion of the closing motion of said inhalation-of-air throttle valve based on said number-of-steps control. The control approach of the step motor type valve gear according to claim 2 to 4 which makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the location equivalent value with which it is near the open position of this inhalation-of-air throttle valve, and this check processing is not performed.

[Claim 6] The control unit of the step motor type valve gear characterized by to have a monitor means is the control unit of the step motor type valve gear which makes a valve gear open and close said valve based on the number-of-steps control on the basis of the predetermined step location of the step motor by which drive connection was carried out, and supervise the driver voltage of said step motor, and an opening target setting means set the opening desired value of said valve as a fixed value when this driver voltage to supervise becomes below a predetermined electrical potential difference.
[Claim 7] It is the control unit of the step motor type valve gear according to claim 6 which said valve is an inhalation-of-air throttle valve prepared in a Diesel engine's inhalation-of-air path, and makes opening desired value of this inhalation-of-air throttle valve which sets said opening target setting means as said immobilization the evacuation location equivalent value according to an engine condition.
[Claim 8] Said opening desired value setting means is the control unit of the step motor type valve gear according to claim 7 which is what makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine operational status the open position of this inhalation-of-air throttle valve, or its near.
[Claim 9] Said opening desired value setting means is the control unit of the step motor type valve gear according to claim 7 or 8 which is what makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the closed position of this inhalation-of-air throttle valve, or its near when abnormalities in a system or ignition switch of the engine concerned is OFF.
[Claim 10] In the control unit of a step motor type valve gear according to claim 7 to 9 On the occasion of the closing motion of said inhalation-of-air throttle valve based on said number-of-steps control, it has further the means which carries out check processing of the relation between the predetermined step location of said step motor, and the opening of said inhalation-of-air throttle valve in the open position of this inhalation-of-air throttle valve. Said opening desired value setting means is the control unit of the step motor type valve gear characterized by making opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition into the location equivalent value with which it is near the open position of this inhalation-of-air throttle valve, and said check processing is not performed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] With a step motor, this invention is adopted as the inhalation-of-air throttle valve of the step motor type valve gear by which a closing motion drive is carried out, especially a Diesel engine, and relates to the control approach of a

suitable valve gear, and a control unit.

[0002]

[Description of the Prior Art] Since output adjustment of a Diesel engine was mainly performed by fuel-oil-consumption control, a not much high precision was not conventionally required of inhalation air content control. However, in order are necessary to secure a lot of amounts of EGR(s) through a lot of exhaust gas reflux (henceforth "EGR") equipment in order to fill the demand of the improvement in emission increasing in recent years and to secure a lot of amounts of EGR(s) in this way, it will be necessary to control the inhalation air content to a Diesel engine itself increasingly minute. And in order to enable such minute inhalation air content control, moreover, development of the step motor type inhalation-of-air throttle valve equipment in which highly precise opening control is possible is furthered independently, without an accelerator pedal being interlocked with.

[0003] With such a valve gear, the shaft of an inhalation-of-air throttle valve is equipped with the step motor by which drive connection was carried out, and the opening control is performed by carrying out the closing motion drive of the above-mentioned inhalation-of-air throttle valve based on the number of steps which rotated this motor from the location on the basis of the predetermined step location of this step motor.

[0004]

[Problem(s) to be Solved by the Invention] By the way, since the output of this motor also declines when the driver voltage (battery voltage) impressed to a step motor falls if it is in such equipment, the driving torque at the time of carrying out the closing motion drive of the inhalation-of-air throttle valve may be insufficient, and the so-called step-out of a step motor may occur. Since it becomes impossible to take correspondence with the number of steps and opening of an inhalation-of-air throttle valve when the step-out of a step motor occurs, it becomes impossible in this way, to perform opening control with this exact inhalation-of-air throttle valve. When the opening control serves as impossible by the step-out of a step motor especially in the case of a Diesel engine's inhalation-of-air throttle valve, it becomes impossible to supply the inhalation air of an initial complement, and there is also a possibility that the fault of the smoke in exhaust gas increasing may arise.

[0005] In addition, although the equipment which maintains opening control of a valve is also known like the equipment of the former, for example, a JP,61-226540,A publication, even when the above-mentioned driver voltage becomes below a predetermined value, the drive rate of a motor is made late, driving torque is secured and driver voltage falls, generating of step-out is not necessarily controlled by this. That is, in order for the opening desired value of the above-mentioned valve itself to change according to engine operational status, it turns around possibility of lapsing into step-out in the place which made the drive rate of a motor late even if, and secured the driving torque, about a usual state. In addition, if it is in the step motor type valve gear from which opening desired value changes not only according to the above-mentioned inhalation-of-air throttle valve but according to a service condition etc., such the actual condition is also what was common in

general.

[0006] This invention is made in view of the above-mentioned actual condition, and the purpose is in offering the control approach of a step motor type valve gear and control unit which can control suitably generating of the step-out accompanying the lowering of electric power of a step motor etc.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention according to claim 1 is the control approach of a step motor type valve gear of making a valve opening and closing said valve based on the number-of-steps control on the basis of the predetermined step location of the step motor by which drive connection was carried out, and when the driver voltage of said step motor is supervised and this driver voltage becomes below a predetermined electrical potential difference, it makes it the summary to make opening desired value of said valve into a fixed value.

[0008] Moreover, in the control approach of a step motor type valve gear according to claim 1, said valve is an inhalation-of-air throttle valve prepared in a Diesel engine's inhalation-of-air path, and invention according to claim 2 makes it the summary for the opening desired value of this inhalation-of-air throttle valve made into a fixed value based on the driver voltage of said step motor become below a predetermined electrical potential difference to be an evacuation location equivalent value according to an engine condition.

[0009] Moreover, invention according to claim 3 makes it the summary to make into the open position of this inhalation-of-air throttle valve, or its near opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition in the control approach of a step motor type valve gear according to claim 2.

[0010] Moreover, in the control approach of a step motor type valve gear according to claim 2 or 3, invention according to claim 4 makes it the summary to make into the closed position of this inhalation-of-air throttle valve, or its near opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition, when abnormalities in a system or ignition switch of the engine concerned is OFF.

[0011] Moreover, invention according to claim 5 is set to the control approach of a step motor type valve gear according to claim 2 to 4. It is what carries out check processing of the relation between the predetermined step location of said step motor, and the opening of said class throttle valve in the open position of this inhalation-of-air throttle valve on the occasion of the closing motion of said inhalation-of-air throttle valve based on said number-of-steps control. Let it be the summary to make opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition into the location equivalent value with which it is near the open position of this inhalation-of-air throttle valve, and this check processing is not performed.

[0012] Moreover, invention according to claim 6 is the control approach of a step motor type

valve gear of making a valve gear opening and closing said valve based on the number-of-steps control on the basis of the predetermined step location of the step motor by which drive connection was carried out, and makes it that summary to have a monitor means supervise the driver voltage of said step motor, and an opening target setting means set the opening desired value of said valve as a fixed value when this driver voltage to supervise becomes below a predetermined electrical potential difference.

[0013] Moreover, invention according to claim 7 is the inhalation-of-air throttle valve by which said valve was prepared in a Diesel engine's inhalation-of-air path in the control device of a step motor type valve gear according to claim 6, and said opening target setting means makes it the summary to make into the evacuation location equivalent value according to an engine condition opening desired value of this inhalation-of-air throttle valve set as said immobilization.

[0014] Moreover, invention according to claim 8 makes it the summary for said opening desired value setting means to be what makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the open position of this inhalation-of-air throttle valve, or its near in the control unit of a step motor type valve gear according to claim 7.

[0015] Moreover, invention according to claim 9 makes it the summary for said opening desired value setting means to be what makes opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition the closed position of this inhalation-of-air throttle valve, or its near, when abnormalities in a system or ignition switch of the engine concerned is OFF in the control unit of a step motor type valve gear according to claim 7 or 8.

[0016] Moreover, invention according to claim 10 is set to the control unit of a step motor type valve gear according to claim 7 to 9. On the occasion of the closing motion of said inhalation-of-air throttle valve based on said number-of-steps control, it has further the means which carries out check processing of the relation between the predetermined step location of said step motor, and the opening of said inhalation-of-air throttle valve in the open position of this inhalation-of-air throttle valve. Said opening desired value setting means makes it the summary to make opening desired value of the inhalation-of-air throttle valve made into the evacuation location equivalent value according to said engine condition into the location equivalent value with which it is near the open position of this inhalation-of-air throttle valve, and said check processing is not performed.

[0017] According to an approach and a configuration according to claim 6 given in above-mentioned claim 1, by making opening desired value of a valve into a fixed value, if the driver voltage of a step motor falls, the closing motion drive of this valve is restricted, and drive control of this step motor comes to be performed so that it may finally hold to predetermined opening. In this way, the drive of a step motor is restricted at the time of a driver voltage fall, and by finally forbidding the drive, generating of the step-out of this motor etc. can be controlled suitably, and can do things now.

[0018] furthermore, according to an approach and a configuration according to claim 7

according to claim 2, generating of the step-out of this motor etc. is suitably controlled by reducing the amount of closing motion drives of an inhalation-of-air throttle valve of drives, i.e., the amount of a step motor, as much as possible by making opening desired value of a step motor into an evacuation location equivalent value at the time of the driver voltage (it being battery voltage if mounted Diesel engine has) fall of a step motor -- things can be done now. Here, an evacuation location is an opening location of the inhalation-of-air throttle valve corresponding to "a different value from the usual desired value." Moreover, this evacuation location is also an opening location of the inhalation-of-air throttle valve which drive control of a step motor becomes difficult, is under the situation that opening control of an inhalation-of-air throttle valve cannot fully be performed, and enables maintenance of operation of a Diesel engine, and control of fault generating at least.

[0019] Furthermore, when according to an approach and a configuration according to claim 8 according to claim 3 it is under the situation that operation of the engine concerned must be maintained and the driver voltage of a step motor falls, securing the inhalation air content more than an initial complement in a Diesel engine's combustion chamber by setting the opening desired value of an inhalation-of-air throttle valve as an open position or its near can be continued. That is, generating of the step-out of a step motor etc. can be controlled, without causing trouble to operation of a Diesel engine.

[0020] Furthermore, according to an approach and a configuration according to claim 9 according to claim 4, when abnormalities in a system, such as a Diesel engine's fuel-injection system, occur, or when an ignition switch is OFF, the inhalation air supplied to a Diesel engine's combustion chamber can be reduced to cutoff or large width of face by setting the opening desired value of an inhalation-of-air throttle valve as a closed position or its near. That is, generating of the step-out of a step motor etc. can be controlled, stopping the engine concerned promptly.

[0021] Furthermore, while according to an approach and a configuration according to claim 10 according to claim 5 forbidding the drive of the step motor accompanying check processing and controlling generating of the step-out of this motor etc. by check processing being made not to perform at the time of the driver voltage fall of a step motor, or the abnormalities in a system of the engine concerned, the incorrect judging at the time of a check can be prevented.

[0022]

[Embodiment of the Invention] The gestalt of the 1 operation which applied the control approach of a step motor type valve gear and control device concerning this invention to the control device of a Diesel engine's inhalation-of-air throttle valve hereafter is explained to a detail.

[0023] First, a Diesel engine's outline in which the valve gear concerning the gestalt of this operation was prepared is explained based on drawing 1 . The inhalation-of-air path 2 is connected to Diesel engine's 1 combustion chamber 12 through the intake valve which is not illustrated. From the upstream, are prepared by the inhalation-of-air throttle valve 4 for adjusting the inhalation air content introduced in the intake temperature sensor 78 for

detecting the pressure sensor 6 for detecting the pressure (atmospheric pressure) of the air cleaner 3 which filters inhalation air, and inhalation air, and the temperature of this inhalation air, and a combustion chamber 12, and it is in this inhalation-of-air path 2.

[0024] The closing motion drive of the inhalation-of-air throttle valve 4 is carried out by the step motor 40 and the drive 5 constituted considering the gear group which carries out drive connection of this step motor 40 and the inhalation-of-air throttle valve 4 as a core. In addition, drive control of the step motor 40 is carried out by the electronic control (henceforth "ECU") 19 for performing various control of Diesel engine 1. Moreover, the full open switch 39 with which the inhalation-of-air throttle valve 4 will be in an ON state in being located in an aperture side rather than the predetermined location near the open position is formed in the above-mentioned drive 5.

[0025] On the other hand, it is in the inhalation-of-air path 2, and the EGR (exhaust gas reflux) path 8 which branches from the flueway 7 connected through the exhaust air bulb of the inhalation-of-air throttle valve 4 which is not illustrated to the downstream in the above-mentioned combustion chamber 12, and joins this inhalation-of-air path 2 is connected further. The EGR control valve 9 by which a closing motion drive is carried out with the actuators 10, such as a diaphragm controlled by the above ECU 19, is formed in this EGR path 8. It becomes possible to set up the rate of the amount of EGR(s) to the inhalation air content introduced in a combustion chamber 12 by said inhalation-of-air throttle valve 4 adjusting an inhalation air content, and adjusting the amount of EGR(s) by this EGR control valve 9, respectively, i.e., an EGR rate, free. Namely, suitable EGR control can be performed now over all Diesel engine's 1 operating range.

[0026] By the way, the injection nozzle 11 for injecting a fuel is formed in Diesel engine's 1 secondary combustion chamber 13. This fuel injection nozzle 11 is connected to the fuel injection pump 14. This fuel injection pump 14 is driven based on rotation of Diesel engine's 1 output shaft 23, and carries out pressurization supply of the fuel to said injection nozzle 11. Moreover, this fuel injection pump 14 is equipped with the timer control valve 15 and the spill valve 16 which adjust fuel injection timing and the injection quantity of the fuel injected from an injection nozzle 11. The actuation is controlled also for these timer control valve 15 and the spill valve 16 by said ECU19.

[0027] in addition, the electromagnetism which detects the heights formed in the peripheral face of this Rota, and outputs the pulse signal corresponding to that rotational speed while Rota (not shown) rotated synchronizing with rotation of Diesel engine's 1 output shaft is prepared in a fuel injection pump 14 -- the rotational frequency sensor 17 which consists of pickup is formed. The output of this engine-speed sensor 17 is incorporated by said ECU19 as a signal which contributes to calculation of Diesel engine's 1 engine speed.

[0028] In addition, the intake-air-temperature information detected by ECU19 with the atmospheric pressure information detected by the above-mentioned pressure sensor 6 or an intake temperature sensor 78 is begun. Accelerator opening information (the amount information of treading in on an accelerator pedal) and on-off information on the IG

(ignition) switch 20 which are detected by the accelerator opening sensor 18, The on-off information on a starting switch 21, the circulating-water-temperature information detected by the coolant temperature sensor 77, the output voltage information on the dc-battery 22 which supplies power to the various electrical machinery and apparatus containing ECU19 or a step motor 40, etc. are incorporated collectively.

[0029] Next, the detail of the drive 5 which makes said inhalation-of-air throttle valve 4 open and close is explained based on drawing 2 - drawing 4 . In addition, drawing 4 shows the passive-movement gear 29 by which the forward plane structure of this drive 5 was prepared for the inhalation-of-air throttle valve 4 and the flank cross-section structure of the drive 5 to drawing 2 in drawing 3 in this drive 5, and the partial cross-section structure of the periphery.

[0030] As shown in drawing 2 , opening area of the inhalation-of-air path 2 is made adjustable, and the inhalation-of-air throttle valve 4 for adjusting the inhalation air content which flows the inside of this path 2 is really being fixed to the valve stem 26 rotatable. This valve stem 26 is supported rotatable by the throttle body 25 connected with said inhalation-of-air path 2. The end (upper part edge of drawing 2) of this valve stem 26 is connected with the above-mentioned throttle body 25 through the return spring 27. And the inhalation-of-air throttle valve 4 is energized by the valve-stem 26 list according to the energization force of this return spring 27 in the direction which makes the inhalation-of-air throttle valve 4 open.

[0031] On the other hand, the passive-movement gear 29 prepared in the gearbox 28 which is a valve stem 26, and with which the throttle body 25 was equipped is already attached in the end (lower part edge of drawing 2) rotatable really. This passive-movement gear 29 meshes with the 2nd middle gear 37 supported rotatable by the pivot 35 prepared in the above-mentioned gearbox 28. Moreover, this 2nd middle gear 37 and the really rotated 1st middle gear 36 are attached in the above-mentioned pivot 35. This 1st middle gear 36 meshes with the drive gear 38 really attached in the output shaft 41 of the step motor 40 with which said gearbox 28 was equipped rotatable. That is, rotation of the output shaft 41 driven with a step motor 40 is transmitted to a valve stem 26 through said drive gear 38, the 1st middle gear 36, the 2nd middle gear 37, and the passive-movement gear 29. And the closing motion drive of said inhalation-of-air throttle valve 4 is carried out by rotation of this valve stem 26.

[0032] In addition, said valve stem 26 is equipped with the lever 32 equipped with the two arm sections 32a and 32b rotatable, as shown in drawing 3 . This lever 32 is connected with said passive-movement gear 29 through the relief spring 31. The lever 32 is energized by the energization force of this relief spring 31 in the direction of a counterclockwise rotation of drawing 3 to the passive-movement gear 29. Moreover, one side 32b of the arm section prepared in the lever 32 is bent in the shape of L character, and is extended at the passive-movement gear 29 side. The point of this arm section 32b is being engaged in the slot 30 formed in the passive-movement gear 29, as shown in drawing 4 . and the lever 32 -- the passive-movement gear 29 -- receiving -- a part for the gap of a slot 30 and the point of

arm section 32b -- relativity -- it is rotatable. However, the point of arm section 32b is usually in contact with the side attachment wall by the side of the direction of a counterclockwise rotation centering on the valve stem 26 of this slot 30 with the energization force of the relief spring 31. And in this condition, the passive-movement gear 29 and a lever 32 are united, and are rotated.

[0033] Moreover, the press section 33 which was prepared in the gearbox 28 and in which the full open switch 39 and contact are possible is formed in the point of another [which was prepared in the lever 32] arm section 32a. The full open switch 39 is contacted in the open position of the inhalation-of-air throttle valve 4, and this press section 33 can set the full open switch 39 to ON. In addition, in the gestalt of this operation, the inhalation-of-air throttle valve 4 is still more rotatable than the above-mentioned open position to an aperture side direction. An open position here is a location of the inhalation-of-air throttle valve 4 in case the opening area of the inhalation-of-air path 2 serves as max. And if the inhalation-of-air throttle valve 4 is further driven from the open position to the aperture side direction, the open drive beyond it will come to be restricted by the stopper which is not illustrated soon. Below, the location of the inhalation-of-air throttle valve 4 at this time is considered as the maximum opening location.

[0034] Furthermore, the close-by-pass-bulb-completely stopper which is not illustrated is formed in the shaft section of a gearbox 28 and the opposite side. This close-by-pass-bulb-completely stopper contacts a stopper in the location where the inhalation-of-air throttle valve 4 serves as a closed position, and regulates the rotation by the side of the closed direction of the inhalation-of-air throttle valve 4 of a lever 32. In addition, suppose that a closed position here means the location of the inhalation-of-air throttle valve 4 in case the opening area of the inhalation-of-air path 2 becomes min, 0 [i.e.,]. However, the passive-movement gear 29 is still more rotatable than a closed position to the closed direction side at this time. When the passive-movement gear 29 rotates to the closed direction side further from the location where said stopper contacted and rotation of a lever 32 was regulated, the passive-movement gear 29 comes to be energized by the energization force of said relief spring 31 in the extraction opposite side.

[0035] Next, the electrical circuit configuration which shows said Diesel engine's 1 control network is explained based on the block diagram shown in drawing 5 . ECU19 is equipped with the read-only memory (ROM) 61 which memorized the various control programs for fuel-oil-consumption control of Diesel engine 1, fuel-injection-timing control, EGR control, inhalation air content control, etc., the map for computing the value corresponding to various conditions, etc. Moreover, ECU19 is equipped with the random access memory (RAM) 62 for memorizing temporarily the central processing unit (CPU) 60 which performs data processing based on the program memorized in this ROM61, and the data inputted from the result of an operation, each sensor, etc. in this CPU60, and the backup RAM63 grade for holding required data also at the time of the current supply cutoff to ECU19. These [CPU60, ROM61, and RAM62] and backup RAM 63 are connected also with the external input circuit 66 and the external output circuit 67 while connecting mutually

through a bus 64.

[0036] On the other hand, in ECU19, the input signal from said pressure sensor 6 and the accelerator opening sensor 18, a coolant temperature sensor 77, and an intake temperature sensor 78 is temporarily stored in a buffer 69. After sequential selection is made by the multiplexer 68 based on the command of CPU60 and the input signal stored in each buffer 69 is changed into a digital signal by A/D converter 65, it is sent to the above-mentioned external input circuit 66. Moreover, after the input signal of the shape of a pulse from the rotational frequency sensor 17 is made binary by the waveform shaping circuit 71, it is sent to the external input circuit 66. Furthermore, the condition of the IG switch 20, a starting switch 21, and the full open switch 39 is also sent as on-off information on these switches. In addition, the IG switch 20 is a switch for controlling starting and a halt of an engine, serves as ON at the time of engine starting, and becomes off at the time of a halt. Moreover, a starting switch 21 is a switch for driving the starter motor which starts an engine, serves as ON at the time of rotation of this starter motor, and becomes off at the time of a halt.

[0037] Furthermore, a part of electrical potential difference supplied from a dc-battery 22 is incorporated through A/D converter 65 in the external input circuit 66. In this way, ECU19 grasps the electrical potential difference VB of the dc-battery 22 supplied to step motor 40 grade.

[0038] On the other hand, the drive circuit 72 of said step motor 40, the drive circuit 73 of the actuator 10 which carries out the closing motion drive of said EGR control valve 9, the drive circuit 74 of the timer control valve 15 of said fuel injection pump 14, and the drive circuit 75 of the spill valve 16 of this fuel injection pump 14 are connected to the external output circuit 67 of ECU19. Based on the result of an operation of CPU60, a command signal is sent to each [these] drive circuits 72-75. And each drive circuits 72-75 drive the above-mentioned step motor 40, an actuator 10, the timer control valve 15, and the spill valve 16 based on this command signal, respectively.

[0039] Next, the configuration and its control mode of said step motor 40 are explained based on drawing 6 - drawing 10 . The flat-surface cross-section structure of a step motor 40 is shown in drawing 6 , and the flank cross-section structure of this motor 40 is shown in drawing 7 . As shown in these drawings, the step motor 40 consists of two stator cups 44 prepared so that said output shaft 41, the really rotatable rotator 42, and a rotator 42 might be surrounded greatly, i.e., an A phase stator cup, and a B phase stator cup 45. The permanent magnet 43 is really formed in the rotator 42 rotatable at the periphery. As the type section Fig. of this step motor 40 is shown in drawing 8 (a) and (b), predetermined angle spacing is set in this permanent magnet 43, and N pole and the south pole of a magnetic pole are formed in it by turns.

[0040] On the other hand, as shown in drawing 6 and drawing 7 , the A phase stator cup 44 and the B phase stator cup 45 are presenting the ring configuration, and said rotator 42 is held in the centrum rotatable. In these stators cup 44 and 45, 2 sets of coils 46, i.e., Ap

respectively. The winding of each [these] coils 46-49 is carried out in the same direction.
[0041] Moreover, it is in these stators cups 44 and 45, and as shown in drawing 8 (a) and (b), the same predetermined angle spacing as the magnetic pole of the permanent magnet 43 of a rotator 42 is set to the inner circumference of the centrum in which the rotator 42 was held, and the upper gear tooth 50 and the lower gear tooth 51 (A phase stator cup 44) or the upper gear tooth 52, and the lower gear tooth 53 (B phase stator cup 45) are formed in it by turns. The upper gear teeth 50 and 52 and the lower gear teeth 51 and 53 of these are excited by an electrical potential difference being impressed to said coils 46-49. In addition, each gear teeth 50 and 51 formed in the A phase stator cup 44 and each gear teeth 52 and 53 formed in the B phase stator cup 45 are formed in the location shifted the one half of the above-mentioned predetermined angle, a part for i.e., a half-gear tooth.
[0042] Next, the electrical circuit configuration of the above-mentioned step motor 40 and its drive circuit 72 is explained based on drawing 9 . In addition, at drawing 9 (a) and (b), the form developed superficially shows typically the relation between the periphery section of the rotator 42 of a step motor 40, and the inner circumference section of each stator cups 44 and 45. Moreover, by this drawing 9 , in order to explain the function of the drive circuit 72 plainly, this is simplified and the electrical circuit configuration is also shown typically.
[0043] As for Ap phase coil 46 and An phase coil 47 which were prepared in the A phase stator cup 44, an electrical potential difference is impressed by DC power supply 58. Ap phase coil switch 54 for permitting or intercepting impression of the electrical potential difference to each coils 47 and 48 and An phase coil switch 55 are formed in the drive circuit 72. By setting each [these] coil switches 54 and 55 to ON, an electrical potential difference is impressed to each coils 47 and 48, and each **** 50 and the lower gear tooth 51 are excited. As point ** was carried out, the winding of each [these] coils 47 and 48 is carried out in the same direction, but as shown in this drawing 9 (a) and (b), the direction of the current energized in coils 47 and 48 is constituted so that it may become hard flow. Therefore, each **** 50 and the lower gear tooth 51 come to be excited by different pole in the time of an electrical potential difference being impressed to Ap phase coil 46, and the time of an electrical potential difference being impressed to An phase coil 47. That is, when an electrical potential difference is impressed to Ap phase coil 46, the upper gear tooth 50 is excited by N pole, and the lower gear tooth 51 is excited by the south pole. On the other hand, when an electrical potential difference is impressed to An phase coil 47, the upper gear tooth 50 is excited by the south pole, and the lower gear tooth 51 is excited by N pole.
[0044] Moreover, the same electrical circuit configuration is adopted also in the B phase stator cup 45 section, and an electrical potential difference is alternatively impressed to each coils 48 and 49 by the on-off change of Bp phase coil switch 56 and Bn phase coil switch 57. And by impressing an electrical potential difference to Bp phase coil 48, the upper gear tooth 52 is excited by N pole, the lower gear tooth 53 is excited by the south pole, by impressing an electrical potential difference to Bn phase coil 49, the upper gear tooth 52 is excited by the south pole, and the lower gear tooth 53 is excited by N pole.
[0045] Next, the principle of operation of the step motor 40 driven by the above-mentioned

drive circuit 72 is explained based on this drawing 9 and drawing 10 . The drive circuit 72 operates based on the command signal of said CPU60, and impresses an electrical potential difference alternatively to any one of the coils 46-49 of coincidence or each stator cups 44 and 45 to one side of each coils 46 and 47 of the A phase stator cup 44, and one side of each coils 48 and 49 of the B phase stator cup 45. The energization mode to each coils 46-49 of a step motor 40 is shown in drawing 10 .

[0046] The drive circuit 72 changes alternatively eight excitation phase modes 0-7 as shown in this drawing 10 , and rotates a step motor 40. In addition, in the case of the excitation phase mode of an odd number, an electrical potential difference is respectively impressed one [at a time] to coincidence to the coils 46 and 47 of each stator cups 44 and 45, and 48 and 49, and when it is an even number, an electrical potential difference is impressed only to any one of the coils 46-49, so that clearly from this drawing 10 .

[0047] Drawing 9 (a) shows the drive circuit 72 in the case of the excitation phase mode 1 (the value of the low order triplet of elstep = 1) shown in drawing 10 , and the mode of a step motor 40. The drive circuit 72 closes Ap phase coil switch 54 and Bp phase coil switch 56, and makes an electrical potential difference impress to Ap phase coil 46 and Bp phase coil 48 at this time. It is impressing an electrical potential difference to these coils 46 and 48, and as for the lower gear tooth 51, like [again] the south pole, the upper gear tooth 52 of the B phase stator cup 45 is excited by N pole, and the lower gear tooth 53 is excited for the upper gear tooth 50 of the A phase stator cup 44 by the south pole on the N pole. At this time, the south pole of the permanent magnet 43 of a rotator 42 is attracted by the upper gear tooth 50 of the A phase stator cup 44 excited by N pole, and the upper gear tooth 52 of the B phase stator cup 45, and can be drawn near to the middle location of both [these] **** 50 and 52. Moreover, similarly, N pole of the permanent magnet 43 of a rotator 42 is attracted by the lower gear tooth 51 of the A phase stator cup 44 excited by the south pole, and the lower gear tooth 53 of the B phase stator cup 45, and can be drawn near to the middle location of both [these] **** 51 and 53. In this way, a rotator 42 is rotated so that the south pole of a permanent magnet 43 may be the same with the middle location of both above-mentioned **** 50 and 52 and N pole of a permanent magnet 43 may be located in the middle location of both above-mentioned **** 51 and 53.

[0048] Then, if excitation phase mode is changed into the mode 3 from the mode 1, as shown in drawing 10 , a switch setup of the drive circuit 72 will be performed so that an electrical potential difference may be shortly impressed to An phase coil 47 and Bp phase coil 48. The drive circuit 72 in the case of the above-mentioned excitation phase mode 3 (the value of the low order triplet of elstep = 3) and the mode of a step motor 40 are shown in drawing 9 (b). this time -- the upper gear tooth 50 of the A phase stator cup 44 -- the south pole -- the upper gear tooth 52 of the B phase stator cup 45 is excited by N pole, and the lower gear tooth 53 comes to be excited for the lower gear tooth 51 by N pole at the south pole. In this way, the south pole of the permanent magnet 43 of a rotator 42 is attracted in the middle location of the lower gear tooth 51 of the A phase stator cup 44 and the upper gear tooth 52 of the B phase stator cup 45 which were excited by N pole, and,

similarly N pole of a permanent magnet 43 is attracted in the middle location of the upper gear tooth 50 of the A phase stator cup 44 and the lower gear tooth 53 of the B phase stator cup 45 which were excited by the south pole. In this way, in this drawing 9 , it rotates by the half-gear tooth rightward, and, as for a rotator 42, only the one half of said predetermined angle rotates an output shaft 41 in the direction of a clockwise rotation. In addition, with the gestalt of this operation, clausilium of the inhalation-of-air throttle valve 4 is carried out because an output shaft 41 (rotator 42) rotates rightward in this drawing 9 , and it has the composition that this valve 4 is opened by rotating leftward.

[0049] As mentioned above, the output shaft 41 of a step motor 40 is rotated because the drive circuit 72 changes excitation phase mode, the inhalation-of-air throttle valve 4 is made to open by specifically changing excitation phase mode to descending order, and this output shaft 41 is rotated in the direction which carries out clausilium of the inhalation-of-air throttle valve 4 by changing excitation phase mode to ascending order.

[0050] By the way, in the control unit of the gestalt of this operation, when rotating a step motor 40, two excitation methods are used properly. Every one above-mentioned excitation phase mode namely, specifically Excitation phase mode is changed to mode 0 -> mode 1 -> mode 2 -- or mode 2 -> mode 1 -> mode 0--. The method rotated while repeating by turns the mode in which only one coil is excited, and the mode in which two coils are excited by coincidence (henceforth "1-2 phase excitation method"), Every two excitation phase modes so that excitation phase mode may always serve as an odd number specifically They are two excitation methods with the method (henceforth "2 phase excitation method") rotated only using the mode in which change excitation phase mode to mode 1 -> mode 3 -> mode 5 -- or mode 5 -> mode 3 -> mode 1--, and two coils are excited by coincidence. In the case of a 1-2 phase excitation method, it is possible to set up finely the rotation angle of the rotator 42 of the step motor 40 per change in excitation phase mode, and opening control of the minute inhalation-of-air throttle valve 4 can be performed. On the other hand, in the case of 2 phase excitation method, it becomes possible to enlarge the rotation angle of the rotator 42 per change in excitation phase mode, and the closing motion rate of the inhalation-of-air throttle valve 4 can be made quick. Thus, he is trying to aim at coexistence of the improvement in precision in opening control of the inhalation-of-air throttle valve 4, and a flattery disposition top by using two excitation methods properly according to a situation.

[0051] In addition, with the gestalt of this operation, the rotation angle per excitation phase mode change at the time of a 1-2 phase excitation method is defined as one step, and opening control of the inhalation-of-air throttle valve 4 is performed with it. Therefore, two steps will rotate at a time for every one excitation phase mode change at the time of 2 phase excitation method.

[0052] Next, the concrete drive control mode of the step motor 40 of the gestalt of this operation is explained to a detail based on drawing 11 - drawing 13 . In addition, with the gestalt of this operation, the travel of the inhalation-of-air throttle valve 4 is grasped from the number of steps of the driven step motor 40, and opening control of the

inhalation-of-air throttle valve 4 is performed based on it. When performing such control, it is necessary to grasp correspondence with the step location of a step motor 40, and the actual opening of the inhalation-of-air throttle valve 4. It may be able to stop however, being able to grasp these correspondences by intercepting energization during the step-out of a step motor 40, or a halt of an engine 1 etc. So, with the gestalt of this operation, initialization processing for deciding the above-mentioned correspondence is performed in advance of opening control of the inhalation-of-air throttle valve 4.

[0053] First, such initialization processing is explained. If this initialization processing is started, CPU60 will check the on-off condition of said full open switch 39 first. And CPU60 drives a step motor 40 in the direction where the full open switch 39 changes, and sets up the step location in the time of this switch 39 changing as a criteria location. A setup of this criteria step location is the step location of the step motor 40 with which the on-off condition of the full open switch 39 changed, and is performed by memorizing the mode value in "0" and the excitation phase mode at that time for the value of the current step elsact as an offset value elsof. Only the number of steps to which this current step elsact drove the inhalation-of-air throttle valve 4 is added at the time of subtraction and clausilium at the time of valve opening. Thus, since it fluctuates with closing motion of the inhalation-of-air throttle valve 4, the value of the present step elsact can grasp the opening of this inhalation-of-air throttle valve 4 from this value. Moreover, step elstep corresponding to the excitation phase which is the sum with the current offset value elsof which was set up in this way, and which it step-elsact(ed) and was memorized is used for opening control of the inhalation-of-air throttle valve 4. The value (0-7) of the low order triplet of this step elstep corresponding to an excitation phase is equivalent to the excitation phase mode value (drawing 10) of the step motor 40 in the present step elsact.

[0054] Next, drive control of the step motor 40 at the time of opening control of the inhalation-of-air throttle valve 4 performed after the above initialization processing is completed is explained. On the occasion of drive control of a step motor 40, CPU60 checks the size relation between the current step elsact and the target step elstrg first, and determines the driving direction of a step motor 40. When the current step elsact is bigger, it drives to a step motor 40 valve-opening-side, and when the target step elstrg is bigger, it is made to drive to a clausilium side. When step elsact current [these] and the target step elstrg are in agreement, since the inhalation-of-air throttle valve 4 already serves as target opening, it holds the excitation phase of a step motor 40 as it is, and holds the current opening of the inhalation-of-air throttle valve 4.

[0055] Moreover, CPU60 also determines the drive method of a step motor 40. As point ** was carried out, the step motor 40 of the gestalt of this operation can drive two methods, the 1-2 phase excitation method which it drives at a time one step for every one excitation phase change, and 2 phase excitation method which it drives at a time two steps. He makes it usually drive a step motor 40 by 2 phase excitation method, and is trying to drive by the 1-2 phase excitation method in the gestalt of this operation, whenever the difference of the case where current plane 1 excitation of the step motor 40 is carried out, the target step

elstrg, and the current step elsact is "1" step.

[0056] In this way, after setting up the driving direction and drive method of a step motor 40, CPU60 changes the current step elsact. the drive method from step elsact current when driving in the valve-opening direction -- responding -- "1" or" -- every [2"] is subtracted. step elsact current when driving in the direction of clausilium -- the same -- carrying out -- "1" or" -- every [2"] is added.

[0057] Opening control is performed so that the current step elsact may be brought close to the target step elstrg as mentioned above, drive control of the step motor 40 may be carried out so that it may be made in agreement, and it may consider as the opening aiming at the inhalation-of-air throttle valve 4.

[0058] Next, processing of the target opening calculation routine which sets up the target step elstrg which is the drive desired value of a step motor 40 is explained based on drawing 11 . In addition, processing of this routine is performed as regular interruption processing for every predetermined time.

[0059] If it shifts to this routine, CPU60 will judge first whether the IG (ignition) switch 20 is off as processing S100. When the deactivate request of OFF 1, i.e., an engine, is advanced for the ignition switch 20, processing of CPU60 shifts to processing S102 here. In this processing S102, CPU60 makes the target step elstrg the value corresponding to the closed position of the inhalation-of-air throttle valve 4. Then, CPU60 ends processing of this routine temporarily.

[0060] When the IG switch 20 is made off, it is necessary to suspend Diesel engine 1 promptly. With the gestalt of this operation, the inhalation-of-air throttle valve 4 is made into a close by-pass bulb completely in such a case, and in order to intercept supply of the inhalation air to an engine 1 and to perform a prompt halt of an engine 1, the target step elstrg is set as the above-mentioned value, and be made to let the inhalation-of-air throttle valve 4 be a close by-pass bulb completely.

[0061] On the other hand, when the IG switch 20 is ON, it judges whether in processing S101, abnormalities have generated CPU60 in fuel-injection systems, such as said fuel injection pump 14, injection nozzle 11, etc. Since it becomes impossible to already control Diesel engine 1 when abnormalities occur in a fuel-injection system, it is necessary to suspend an engine 1 promptly. Therefore, also when abnormalities have occurred in the fuel-injection system, CPU60 shifts to processing of processing S102, sets the value corresponding to the closed position of the inhalation-of-air throttle valve 4 as the target step elstrg, and he is trying to suspend an engine 1 promptly. And CPU60 ends processing of this routine after that temporarily.

[0062] When the abnormalities of a fuel-injection system have not occurred, CPU60 judges whether battery voltage VB is higher than 10V in processing S103. When battery voltage VB is less than [10V], the driver voltage of a step motor 40 is insufficient, and an output declines. It will be in the condition of being easy to generate the step-out of a step motor 40 because the driving torque at the time of driving the inhalation-of-air throttle valve 4 in such a case runs short. Therefore, in processing S104, when it is judged that this battery

voltage VB is less than [10V] (NO), CPU60 ends processing of this routine here temporarily, after using the target step elstrg as "+9" step. In addition, this value "+9" step is the number of steps of the step motor 40 with which check processing mentioned later is performed and in which exists out of range and the inhalation-of-air throttle valve 4 can be located near the open position. Moreover, as long as the normal condition is maintained at this time, said full open switch 39 does not serve as ON. Thus, when battery voltage VB becomes less than [10V], while locating the inhalation-of-air throttle valve 4 near the open position by fixing the target step elstrg to the above-mentioned value, he is trying to forbid driving a step motor 40 more than it.

[0063] In addition, on the device, as point ** was carried out, if the inhalation air of an initial complement is secured, even if Diesel engine 1 will increase the quantity of an inhalation air content more than it, he can continue operation convenient. Therefore, at the time of the fall of battery voltage VB, the inhalation-of-air throttle valve 4 is evacuated near the open position, by setting up the target step elstrg which can secure sufficient inhalation air content, Diesel engine 1 is convenient and the operation comes to be maintained at it.

[0064] On the other hand, in the previous processing S103, when it judges that battery voltage VB is larger than 10V, CPU60 computes the target step elstrg in processing S105 based on the two-dimensional map illustrated at drawing 12 on the basis [value / Qfinc / the engine rotational frequency NE and / fuel-oil-consumption command] of correspondence. Moreover, according to the atmospheric pressure detected by the pressure sensor 6, the circulating water temperature detected by the coolant temperature sensor 77, the atmospheric temperature detected by the large atmospheric temperature sensor 78, the value is amended so that the suitable inhalation-target step elstrg computed here air content according to Diesel engine's 1 service condition may be secured.

[0065] In this way, after setting up the target step elstrg, CPU60 judges whether the target step elstrg is under the aforementioned "+9" step as processing of processing S106. In this processing S106, when judged with the target step elstrg being more than the aforementioned "+9" step, CPU60 ends processing of this routine temporarily, after making off the completion flag exchkend of check processing in processing S107.

[0066] In addition, when the target step elstrg became under the aforementioned "+9" step, the full open command which considers the inhalation-of-air throttle valve 4 as full open should be taken out with the gestalt of this operation. And check processing which checks that the opening of the inhalation-of-air throttle valve 4 on the control grasped from the number of steps of a step motor 40 whenever a full open command is issued, and actual opening have agreed is performed. Said completion flag exchkend of check processing is used for the activation judging of check processing with the check processing demand flag exglchk mentioned later. In addition, this completion flag exchkend of check processing is set to ON when check processing is completed, and when the target step elstrg turns into more than "+9" step, it is made off.

[0067] Now, in the previous processing S106, when judged with the target step elstrg being

under the aforementioned "+9" step, CPU60 judges whether the completion flag exchkend of check processing is ON in processing S108. Also when this completion flag exchkend of check processing is ON, let the target step elstrg be "+9" step. In this way, he is trying to hold the target step elstrg to "+9" step, when check processing is already completed at the time of this full open command output until this full open command is lifted. It is as above-mentioned that it is equivalent to the opening location where the number of steps called this "+9" step is near the open position of the inhalation-of-air throttle valve 4, and check processing is not performed.

[0068] On the other hand, when the completion flag exchkend of check processing is OFF, in processing S110, CPU60 uses the target step elstrg as "-2" step, and ends processing of this routine by setting the check processing demand flag exglchk to ON further temporarily. The value of -two of this target step elstrg here At the time of the check of the on-off condition of the full open switch 39, the opening of the inhalation-of-air throttle valve 4 by considering as the opening location by the side of valve opening more nearly further than the opening location where this switch 39 changes from OFF to ON It is the step location set up so that the incorrect judging resulting from the chattering of the full open switch 39 which changes to ON and is generated by vibration of Diesel engine 1 etc. might not produce this switch 39 certainly.

[0069] Next, processing of the check manipulation routine which checks correspondence with the opening of the inhalation-of-air throttle valve 4 on the control grasped from the present step elsact of a step motor 40 and the opening of the actual inhalation-of-air throttle valve 4 grasped by the on-off change of the full open switch 39 is explained based on the flow chart of this routine shown in drawing 13 .

[0070] In addition, processing of this routine is started as interruption processing of ** in which a step motor 40 will be in an excitation change condition. In addition, the period which will be in an excitation change condition is computed by CPU60 based on the drive condition of a step motor 40, Diesel engine's 1 operational status, etc. Moreover, the closing motion rate of the inhalation-of-air throttle valve 4 is adjusted by the period which will be in this excitation change condition being changed.

[0071] now -- if it shifts to processing of this routine -- first -- processing S200 -- setting -- CPU60 -- the acknowledge request flag exglchk -- ON -- it is -- in addition -- and it checks whether the current step elsact is under "+7" step. In addition, when this acknowledge request flag exglchk serves as ON, it is as above-mentioned that the target step elstrg to a step motor 40 is set as "-2." In this processing S200, when both both conditions are fulfilled, CPU60 shifts to processing S201. In this processing S201, it judges whether CPU60 has the opening location of whether the current step elsact is "+6" step and the current inhalation-of-air throttle valve 4 in the opening location by the side of clausilium by six steps rather than an open position.

[0072] When the criteria of this processing S201 are fulfilled, processing of CPU60 shifts to processing S202. In this processing S202, CPU60 checks the on-off condition of the full open switch 39. At this time, if the full open switch 39 is off, processing of CPU60 will once

shift to the drive control routine of the step motor 40 which carried out point **. In addition, CPU60 makes late the modification period of the excitation phase which carried out point ** at the time of the check of the full open switch 39 here. In this way, time amount is secured until it is completed by damping of a step motor 40, and it enables it to ensure the check of a switch condition by making the modification period of an excitation phase late.

[0073] If normal actuation is performed, only the part equivalent to six steps of a step motor 40 is located in a clausilium side, and this full open switch 39 of the inhalation-of-air throttle valve 4 at this time must be more nearly off than an open position. And conversely, if the full open switch 39 serves as ON in the above-mentioned processing S202, the correspondence relation between the step location of a step motor 40 and the opening location of the inhalation-of-air throttle valve 4 will not be in agreement. In this case, CPU60 shifts to processing of processing S203, and performs processing at the time of abnormalities noting that a certain abnormalities have occurred.

[0074] At the time of this abnormality, as processing, CPU60 performs again initialization processing which carried out point **, and redoes a setup of a criteria step location. It can be possible for the step-out of a step motor 40 to make its correspondence relation between the step location of a step motor 40 and the opening location of the inhalation-of-air throttle valve 4 correspond again by resetting of this criteria step location, if the cause of the above-mentioned abnormalities is a cause, and opening control of this inhalation-of-air throttle valve 4 can be again performed now. When this setting processing is not performed normally, failure of the full open switch 39, fixing of a step motor 40 and the inhalation-of-air throttle valve 4, etc. are judged to be what the abnormalities which cannot be restored generated easily in the control system of the inhalation-of-air throttle valve 4. In this case, CPU60 fixes the inhalation-of-air throttle valve 4 to a current opening location by holding the excitation phase of a step motor 40 in the current condition, suspends opening control of this valve 4 henceforth, and also suspends EGR control further. Moreover, it deals with restricting fuel oil consumption etc., and enables it to maintain operation of Diesel engine 1.

[0075] Moreover, with the gestalt of this operation, even if restoration of opening control of the inhalation-of-air throttle valve 4 is attained by processing at the time of the above-mentioned abnormalities, when an abnormality judging is made more than a predetermined count after this starting of Diesel engine 1, it was judged as what abnormalities generated in the control system similarly, and has dealt with a halt of opening control of the inhalation-of-air throttle valve 4 etc.

[0076] On the other hand, when not fulfilling the criteria of said processing S201 (i.e., when the current step elsact is below "+5" step), CPU60 shifts to processing S204. In this processing S204, it judges whether CPU60 is "-2" step whose current step elsact corresponds with the target step elstrg. Here, if the current step elsact has not reached "-2" step, it once shifts to the drive control routine of the step motor 40 which carried out point **. On the other hand, if the current step elsact has reached "-2" step, in processing S205, as for CPU60, the on-off condition of the full open switch 39 will be checked. If normal

actuation is performed at this time, the inhalation-of-air throttle valve 4 is further located in a valve-opening side rather than the open position, and the full open switch 39 should serve as ON. Therefore, when the full open switch 39 is off in this processing S205, CPU60 shifts to the processing S203 which carried out point **, and performs processing at the time of as same the abnormalities as the point.

[0077] Moreover, if the full open switch 39 serves as ON in processing S205, it can check that the correspondence relation between the step location of a step motor 40 and the opening location of the inhalation-of-air throttle valve 4 is normal. After CPU's60 shifting to processing S206 at this time and making ON and the acknowledge request flag exglchk off for said completion flag exchkend of a check, it shifts to the drive control routine of a step motor 40. As point ** was carried out, the completion flag exchkend of a check serves as ON, when the full open command is not issued, it is presupposed that it is off and check processing is completed. Thus, whenever a full open command is taken out with setting up the completion flag exchkend of a check, check processing is made not to be performed only once.

[0078] Moreover, on the other hand, in said processing S200, when the acknowledge request flag exglchk is OFF and the current step elsact is more than "+7" step, CPU60 shifts to processing S207. In this processing S207, CPU60 judges whether the current step elsact is more than "+7" step. And when the acknowledge request flag exglchk is off, it shifts to the drive control routine of a step motor 40 as it is, and when step elsact current [this] is under "+7" step, if the acknowledge request flag exglchk is more than "+7" step, the on-off condition of the full open switch 39 will already be checked by processing S208. Also at this time, the modification period of an excitation phase is made late, and CPU60 is raising check precision for it. If normal actuation is performed, the inhalation-of-air throttle valve 4 at this time is located in a clausilium side, and its full open switch 39 must be more nearly off than the change location of the full open switch 39. Therefore, if the full open switch 39 serves as ON in the above-mentioned processing S208, it will be thought that a certain abnormalities have occurred. In this case, CPU60 shifts to processing S203, and performs processing at the time of previous abnormalities. On the other hand, in the above-mentioned processing S208, it shifts to the drive control routine of the step motor 40 which once carried out point ** noting that the normal condition was maintained, when a negative (NO) judgment was made (i.e., when [with the off full open switch 39 / whose current step elsact is more than "+7" step] a purport judgment is made).

[0079] As explained above, according to the gestalt of this operation, effectiveness as taken below can be acquired now.

(1) Battery voltage can fall and generating of step-out can be sharply controlled now by holding the target opening of the inhalation-of-air throttle valve 4, and having forbidden the drive of a step motor 40, when the electrical potential differences impressed to a step motor 40 ran short.

[0080] (2) Moreover, by making target opening of the inhalation-of-air throttle valve 4 at that time into near full open, on condition that an ignition switch 21 is ON, this

inhalation-of-air throttle valve 4 can be evacuated to the location which can supply the inhalation air more than the amount needed at least to Diesel engine 1, and operation of Diesel engine's 1 after that can be performed now convenient.

[0081] (3) moreover, the opening by which check processing is performed in the target opening at that time -- supposing that it is out of range -- check processing -- facing -- misjudgment -- a law can be prevented now. Moreover, since the drive of the step motor 40 accompanying check processing can also be forbidden, generating of the step-out of this motor 40 can also be controlled further.

[0082] (4) Moreover, when abnormalities, such as a case where it is presupposed that an ignition switch 21 is off, and a fuel-injection system, occur, by giving priority to the processing for which this inhalation-of-air throttle valve 4 is evacuated to a closed position as a value corresponding to a closed position for the target opening of the inhalation-of-air throttle valve 4, inhalation air is intercepted and Diesel engine 1 can be suspended promptly.

[0083] (5) On the occasion of a halt in the evacuation location of the inhalation-of-air throttle valve 4, as the excitation condition of a step motor 40 is held, generating of the deflection of the inhalation-of-air throttle valve 4 by inhalation-of-air pulsation or vibration of Diesel engine 1 can be avoided. As a result, the fall of the dependability of the inhalation-of-air throttle valve 4 by the unnecessary deflection or the full open switch 39 can be avoided now.

[0084] In addition, the gestalt of operation of this invention may be changed as follows.

- When abnormalities, such as a case where it is presupposed that an ignition switch 21 is off, and a fuel-injection system, occur, the opening location to which the inhalation-of-air throttle valve 4 is evacuated may be not only a closed position but its near.

[0085] - The full open switch 39 may be the thing of a type which is prepared in the throttle body 25 interior in which what [not only] is prepared in the interior of the gearbox 28 of a drive 5 like the gestalt of the above-mentioned implementation but the inhalation-of-air throttle valve 4 was formed, and checks the opening location of the inhalation-of-air throttle valve 4 directly, or a thing of a type which is prepared in the exterior of a throttle body 25 and checks the opening location based on the rotation include angle of a valve stem 26. Moreover, if it is equipment which checks the opening location of the inhalation-of-air throttle valve 4, and can direct that, it is not necessary to be necessarily a switch.

[0086] - It is good also as a control structure which does not perform the above-mentioned check processing.

- What is necessary is for the value (=10V) of battery voltage VB made into the standard at the time of holding the target opening of the inhalation-of-air throttle valve 4 etc. to be arbitrary, and just to set up these values in the gestalt of this operation, as boundary condition to which the driver voltage of a step motor 40 is insufficient for, and an output falls.

[0087] - With the gestalt of the above-mentioned implementation, although a Diesel engine's inhalation-of-air throttle valve was explained, when the drive power supplied to a

step motor is insufficient, the control which holds the drive desired value of this step motor, and evacuates a control valve to predetermined opening can be applied to the control valve driven with other step motors, for example, an EGR valve, a gasoline engine's throttle valve, etc.

[0088]

[Effect of the Invention] According to an approach and a configuration according to claim 6 according to claim 1, the drive of a step motor is restricted at the time of a driver voltage fall, and by finally forbidding the drive, generating of the step-out of this motor etc. can be controlled suitably, and can do things now.

[0089] Furthermore, according to an approach and a configuration according to claim 7 according to claim 2, generating of the step-out of this motor etc. can be suitably controlled now by reducing the amount of drives of a step motor as much as possible by making opening desired value of a step motor into an evacuation location equivalent value at the time of the driver voltage fall of a step motor.

[0090] Furthermore, according to an approach and a configuration according to claim 8 according to claim 3, when the driver voltage of a step motor falls, by evacuating an inhalation-of-air throttle valve to an open position or its near, securing now the inhalation air content more than an initial complement in a Diesel engine's combustion chamber can be continued, and operation of a Diesel engine can be maintained suitably.

[0091] Furthermore, when according to an approach and a configuration according to claim 9 according to claim 4 an ignition switch is OFF when abnormalities in a system, such as a Diesel engine's fuel-injection system, occur or, by evacuating an inhalation-of-air throttle valve to a closed position or its near, the inhalation air supplied to a Diesel engine's combustion chamber can be reduced to cutoff or large width of face, and the engine concerned can be stopped promptly.

[0092] Furthermore, while according to an approach and a configuration according to claim 10 according to claim 5 forbidding the drive of the step motor accompanying check processing and controlling generating of the step-out of this motor etc. by check processing being made not to perform at the time of the driver voltage fall of a step motor, or the abnormalities in a system of the engine concerned, the incorrect judging at the time of a check can be prevented.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Schematic drawing showing the configuration of the Diesel engine for which the control device of the inhalation-of-air throttle valve concerning 1 operation gestalt of this invention was prepared.

[Drawing 2] The sectional view showing an inhalation-of-air throttle valve and the flank cross-section structure of the drive.

[Drawing 3] The front view showing the forward plane structure of the drive of an

inhalation-of-air throttle valve.
[Drawing 4] The fragmentary sectional view of the drive of this inhalation-of-air throttle valve.
[Drawing 5] The block diagram showing a Diesel engine's electric configuration.
[Drawing 6] The sectional view showing the flat-surface cross-section structure of a step motor.
[Drawing 7] The sectional view showing the flank cross-section structure of this step motor.
[Drawing 8] Schematic drawing showing the outline configuration of this step motor.
[Drawing 9] Schematic drawing showing the electrical circuit configuration and drive mode of this step motor.
[Drawing 10] Drawing showing the energization mode of each coil of a step motor.
[Drawing 11] The flow chart which shows the procedure of a target opening calculation routine.
[Drawing 12] The graph which shows the relation between a Diesel engine's fuel oil consumption and an engine rotational frequency, and the target step of a step motor.
[Drawing 13] The flow chart which shows the procedure of the drive control routine of a step motor.
[Description of Notations]
1 [-- Inhalation-of-air throttle valve drive,] -- A Diesel engine, 2 -- An inhalation-of-air path, 4 -- An inhalation-of-air throttle valve, 5 6 [-- EGR control valve,] -- An intake-pressure sensor, 7 -- A flueway, 8 -- An EGR path, 9 19 -- An electronic control (ECU), 20 -- IG switch, 21 -- Starting switch, 22 [-- A lever, 33 / -- Press section,] -- A dc-battery, 26 -- A valve stem, 29 -- A passive-movement gear, 32 35 [-- Drive gear,] -- A pivot, 36 -- The 1st middle gear, 37 -- The 2nd middle gear, 38 39 [-- Rotator,] -- A full open switch, 40 -- A step motor, 41 -- An output shaft, 42 43 [-- Ap phase coil, 47 / -- An phase coil, 48 / -- Bp phase coil, 49 / -- Bn phase coil, 60 / -- CPU, 72 / -- Drive circuit.] -- A permanent magnet, 44 -- An A phase stator cup, 45 -- A B phase stator cup, 46